Thoughts about bias correction in CFSv1 and CFSv2

Huug van den Dool and Suranjana Saha 30 sept 2014

From the brochure:

"Corrections of mean bias generally rely on a set of hindcasts or retrospective forecasts to define the model climate, which is then subtracted from the forecast to define a predicted anomaly."

However, however

1. How should the hindcasts be designed
2. How should hindcasts (if already made) be used, and used optimally?
3. How to connect hindcasts to independent real time (RT) forecasts.

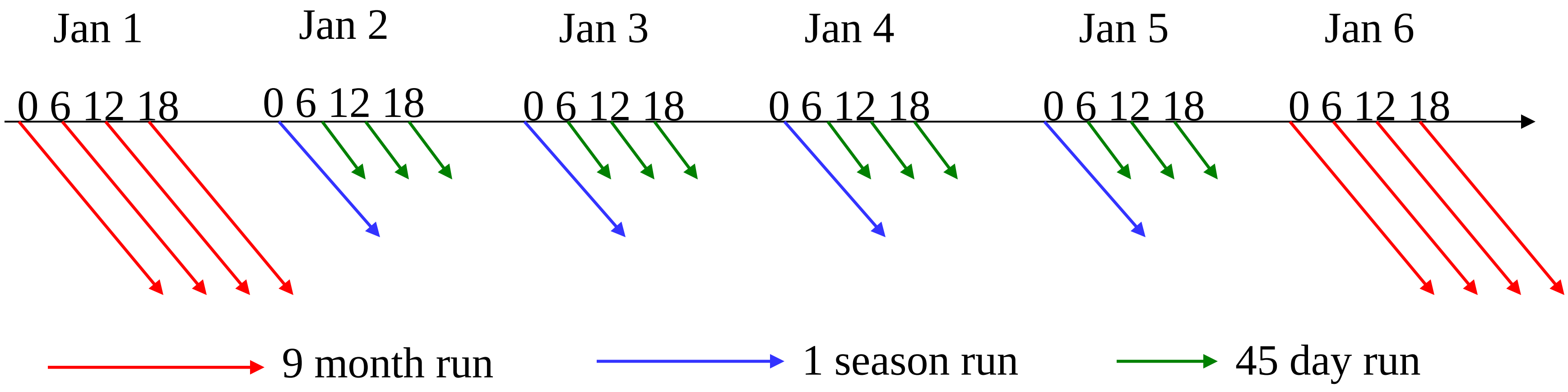
(There is also a question of bias correction on hindcasts themselves)

Research Interests

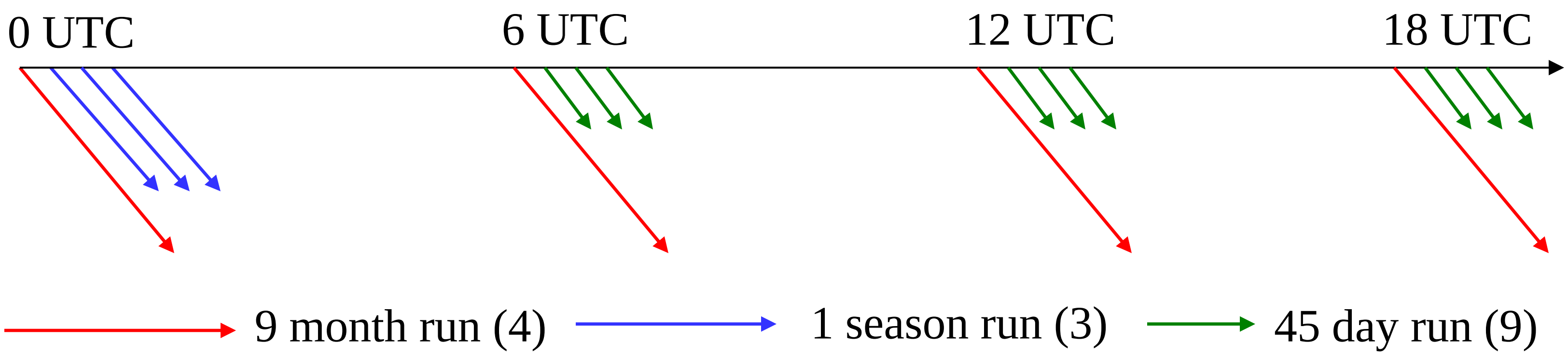
Hindcasts ←-----→ Real Time

Operational Opportunities&Constraints

Daily instantaneous data
Monthly mean data
Ensembles as per bursts on the 1st of the month (truth in labelling?)
Ensembles in a lagged mode
1 cycle a day (0Z)
All cycles a day (0,6,12,18Z), every day

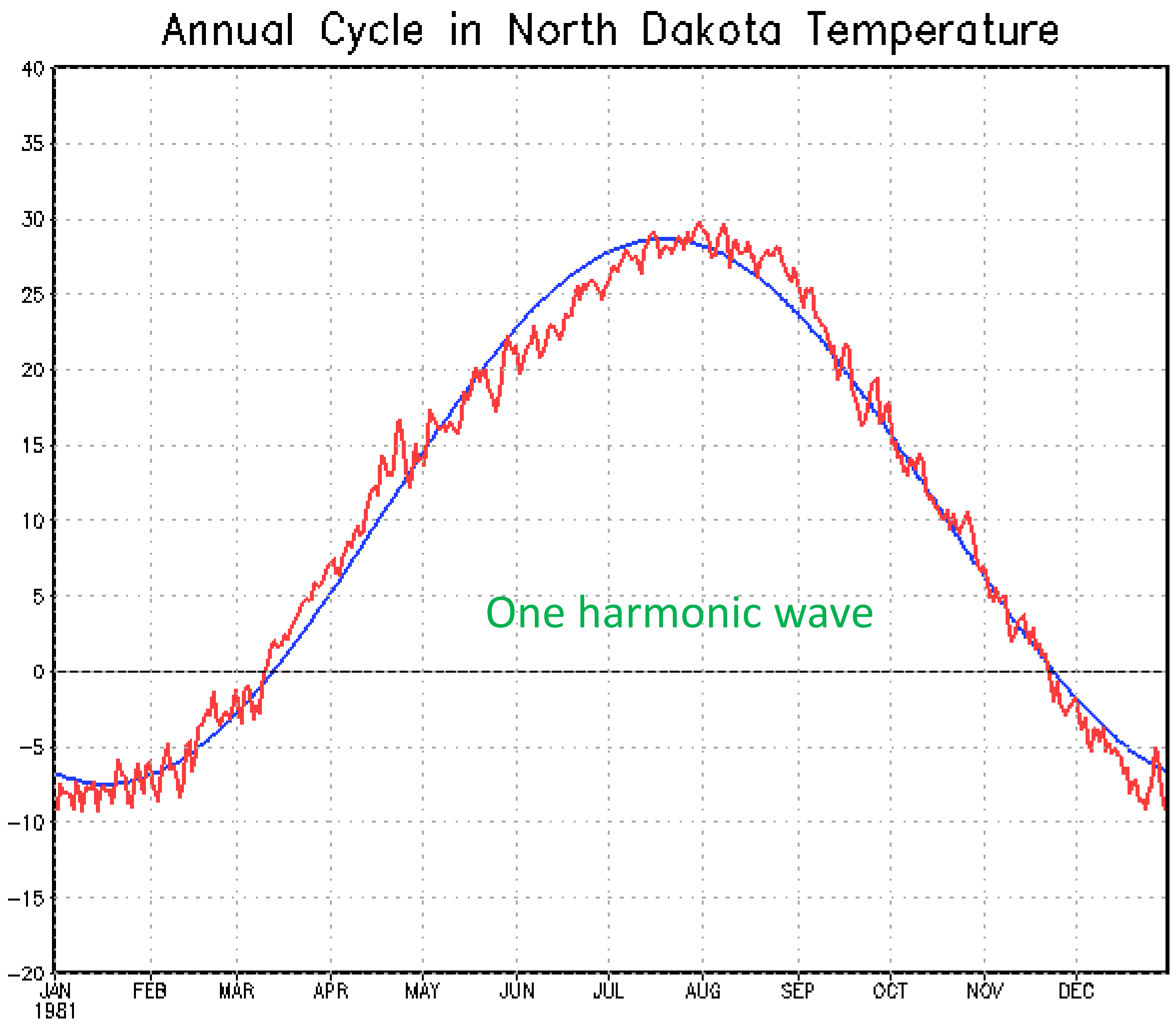


Hindcast ↑ and Real Time ↓



Harmonic Climatology

Basic example:

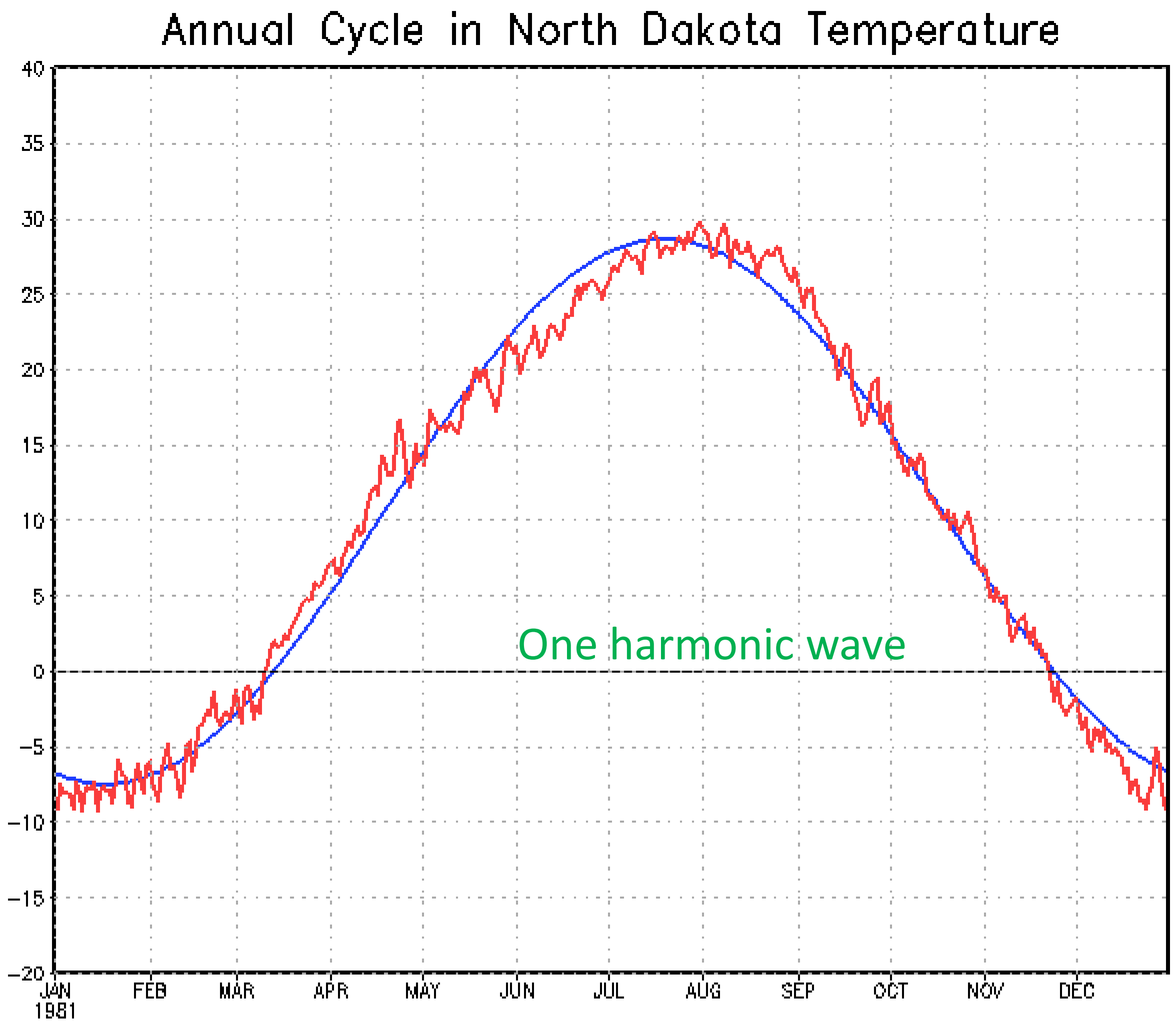


First one makes multi year means For Jan, 1, Jan 2, thru Dec, 31. This yields the wiggly red line

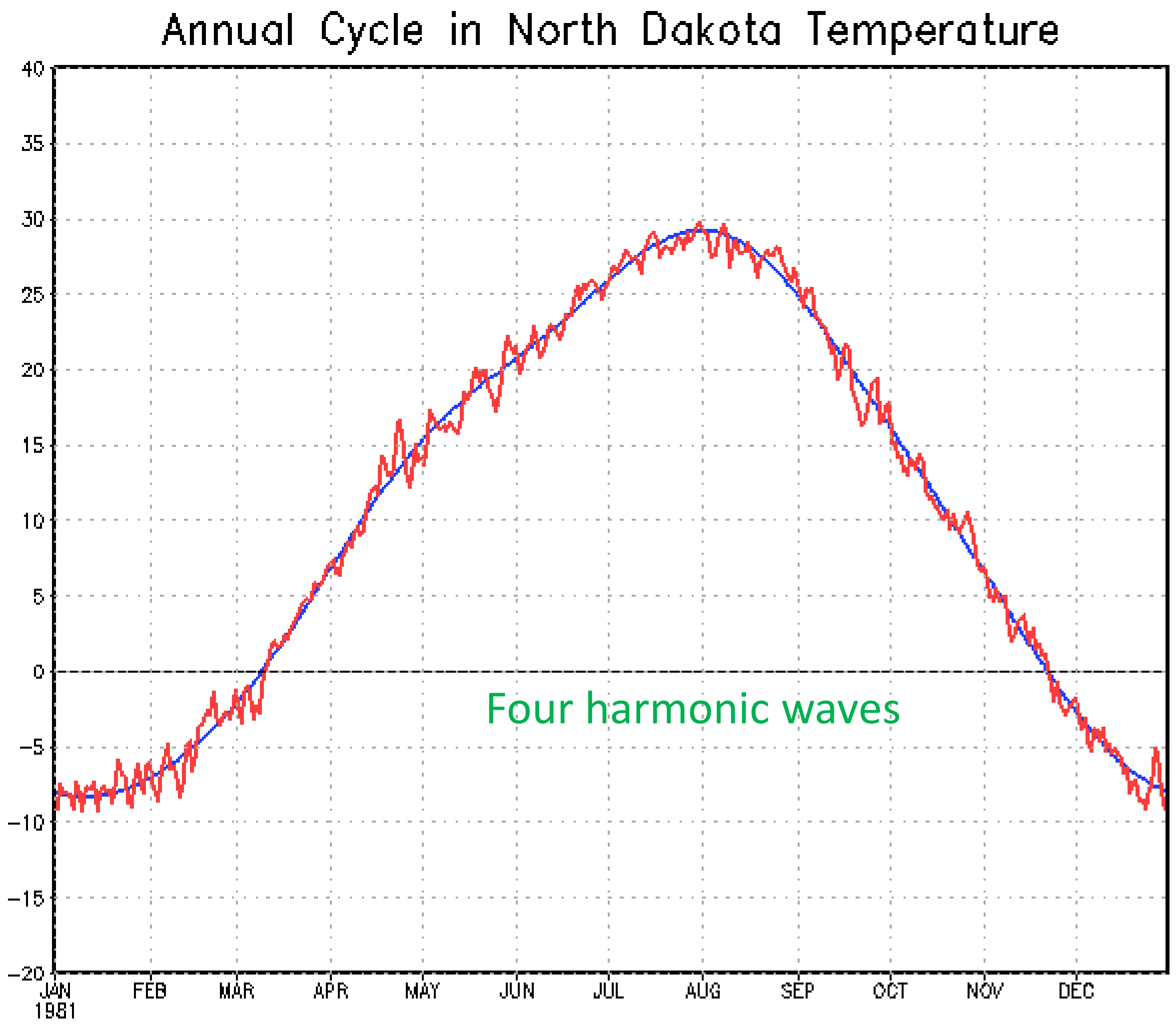
Then one fits an harmonic of period 365 days.

Unit is degree C.
X-axis are days 1-365

Residual = 1.54C (relative to raw daily climo, i.e. red vs blue)



Is a single harmonic enough? How about four?



Four looks better, but this is somewhat subjective.

Origin of harmonic smoothing/interpolation at CPC

Epstein, Edward S., 1988: A Spectral Climatology. *J. Climate*, **1**, 88–107.

Epstein, E. S., A. G. Barnston, 1988: A Precipitation Climatology of 5-Day Periods, 1988, *NOAA Tech. Rep*. NWS 41.

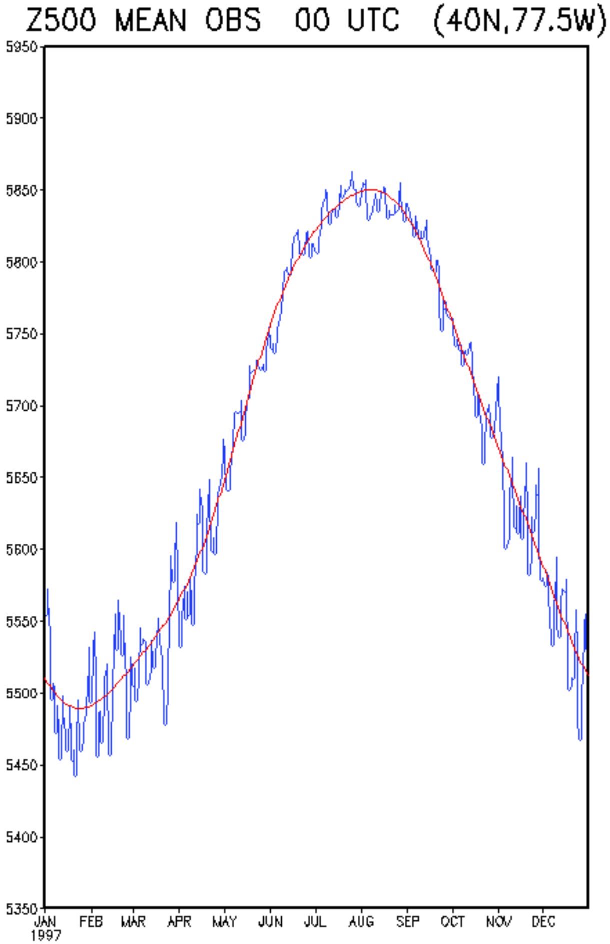
Epstein, E. S., A. G. Barnston, 1990: A Precipitation Climatology of 5-Day Periods. *J. Climate*, **3**, 218–236.

Epstein, Edward S., 1991: Determining the Optimum Number of Harmonies to Represent Normals Based on Multiyear Data. *J. Climate*, **4**, 1047–1051.

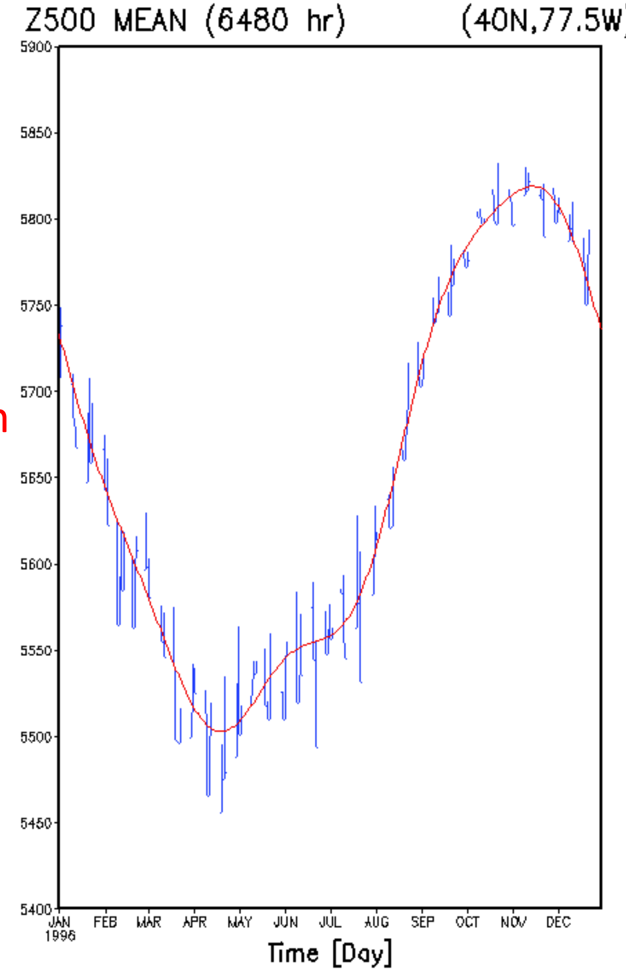
Compare the above to

B. Narapusetty, Timothy DelSole, Michael K. Tippett, 2009: Optimal Estimation of the Climatological Mean. *J. Climate*, **22**, 4845–4859.

Epstein, Edward S., 1991: On Obtaining Daily Climatological Values from Monthly Means. *J. Climate*, **4**, 365–368.



Example from CFSv1



On the left a analysis climatology of Z500 at some gridpoint.
On the right a climatology of Z500 of hindcasts at 6480 hours at the same point.

The model climatology serves two purposes:

1) to remove systematic error in subsequent real time forecasts by same model&system,
and 2) to interpolate hindcast info to starting days from which no hindcasts were available

(incidentally: same is done for stand dev).

In CFSv2 practice: 73 numbers go in, 365(366) come out. For each gridpoint, each forecast lead, each variable, and each cycle.

Harmonic climatologies achieve both smoothing and interpolation

Below are references to the massive use in Reanalysis:

- Schemm, J-K. E., H. M. van den Dool, J. Huang, and S. Saha, 1998: Construction of daily climatology based on the 17-year NCEP-NCAR reanalysis. *Proceedings of the First WCRP International Conference on Reanalyses*. Silver Spring, Maryland, USA. 290-293.

and in Reanalysis + Reforecasting:

- Johansson, Å., Catherine Thiaw and Suranjana Saha, 2007: CFS retrospective forecast daily climatology in the EMC/NCEP CFS public server. See http://cfs.ncep.noaa.gov/cfs.daily.climatology.doc
- Suranjana Saha, Huug van den Dool and Åke Johansson 2011: CFSv2 Retrospective Forecast and Calibration Climatologies. Available from http://cfs.ncep.noaa.gov/cfsv2/docs.html.

- We now have gribbed gridded climos following Epstein's procedure of everything under the sun.

About Monthly Data (leads 1-9)

- Compared to daily data a nightmare, relatively speaking. Why??

1. Need to understand CPC's seasonal prediction release schedule
2. Need to understand the grouping of lagged hindcasts into operationally doable ensemble
3. Reading of grib files of time mean data (technicalities had to be invented on the fly)
4.

Mid-January release
12 Dec at 0000, 0600, 1200, and 1800 UTC
17 Dec at 0000, 0600, 1200, and 1800 UTC
22 Dec at 0000, 0600, 1200, and 1800 UTC
27 Dec at 0000, 0600, 1200, and 1800 UTC
1 Jan at 0000, 0600, 1200, and 1800 UTC
6 Jan at 0000, 0600, 1200, and 1800 UTC

Mid-February release
11 Jan at 0000, 0600, 1200, and 1800 UTC
16 Jan at 0000, 0600, 1200, and 1800 UTC
21 Jan at 0000, 0600, 1200, and 1800 UTC
26 Jan at 0000, 0600, 1200, and 1800 UTC
31 Jan at 0000, 0600, 1200, and 1800 UTC
5 Feb at 0000, 0600, 1200, and 1800 UTC

Mid-March release
10 Feb at 0000, 0600, 1200, and 1800 UTC
15 Feb at 0000, 0600, 1200, and 1800 UTC
20 Feb at 0000, 0600, 1200, and 1800 UTC
25 Feb at 0000, 0600, 1200, and 1800 UTC
2 Mar at 0000, 0600, 1200, and 1800 UTC
7 Mar at 0000, 0600, 1200, and 1800 UTC

Mid-April release
12 Mar at 0000, 0600, 1200, and 1800 UTC
17 Mar at 0000, 0600, 1200, and 1800 UTC
22 Mar at 0000, 0600, 1200, and 1800 UTC
27 Mar at 0000, 0600, 1200, and 1800 UTC
1 Apr at 0000, 0600, 1200, and 1800 UTC
6 Apr at 0000, 0600, 1200, and 1800 UTC

Mid-May release
11 Apr at 0000, 0600, 1200, and 1800 UTC
16 Apr at 0000, 0600, 1200, and 1800 UTC
21 Apr at 0000, 0600, 1200, and 1800 UTC
26 Apr at 0000, 0600, 1200, and 1800 UTC
1 May at 0000, 0600, 1200, and 1800 UTC
6 May at 0000, 0600, 1200, and 1800 UTC

Mid-June release
11 May at 0000, 0600, 1200, and 1800 UTC
16 May at 0000, 0600, 1200, and 1800 UTC
21 May at 0000, 0600, 1200, and 1800 UTC
26 May at 0000, 0600, 1200, and 1800 UTC
31 May at 0000, 0600, 1200, and 1800 UTC
5 Jun at 0000, 0600, 1200, and 1800 UTC

Saha et al 2014
CFSv2 paper.

Mid-July release
10 Jun at 0000, 0600, 1200, and 1800 UTC
15 Jun at 0000, 0600, 1200, and 1800 UTC
20 Jun at 0000, 0600, 1200, and 1800 UTC
25 Jun at 0000, 0600, 1200, and 1800 UTC
30 Jun at 0000, 0600, 1200, and 1800 UTC
5 Jul at 0000, 0600, 1200, and 1800 UTC

Mid-August release
10 Jul at 0000, 0600, 1200, and 1800 UTC
15 Jul at 0000, 0600, 1200, and 1800 UTC
20 Jul at 0000, 0600, 1200, and 1800 UTC
25 Jul at 0000, 0600, 1200, and 1800 UTC
30 Jul at 0000, 0600, 1200, and 1800 UTC
4 Aug at 0000, 0600, 1200, and 1800 UTC

Mid-September release
9 Aug at 0000, 0600, 1200, and 1800 UTC
14 Aug at 0000, 0600, 1200, and 1800 UTC
19 Aug at 0000, 0600, 1200, and 1800 UTC
24 Aug at 0000, 0600, 1200, and 1800 UTC
29 Aug at 0000, 0600, 1200, and 1800 UTC
3 Sep at 0000, 0600, 1200, and 1800 UTC

Mid-October release
8 Sep at 0000, 0600, 1200, and 1800 UTC
13 Sep at 0000, 0600, 1200, and 1800 UTC
18 Sep at 0000, 0600, 1200, and 1800 UTC
23 Sep at 0000, 0600, 1200, and 1800 UTC
28 Sep at 0000, 0600, 1200, and 1800 UTC
3 Oct at 0000, 0600, 1200, and 1800 UTC

Mid-November release (28 members)
8 Oct at 0000, 0600, 1200, and 1800 UTC
13 Oct at 0000, 0600, 1200, and 1800 UTC
18 Oct at 0000, 0600, 1200, and 1800 UTC
23 Oct at 0000, 0600, 1200, and 1800 UTC
28 Oct at 0000, 0600, 1200, and 1800 UTC
2 Nov at 0000, 0600, 1200, and 1800 UTC
7 Nov at 0000, 0600, 1200, and 1800 UTC

Mid-December release
12 Nov at 0000, 0600, 1200, and 1800 UTC
17 Nov at 0000, 0600, 1200, and 1800 UTC
22 Nov at 0000, 0600, 1200, and 1800 UTC
27 Nov at 0000, 0600, 1200, and 1800 UTC
2 Dec at 0000, 0600, 1200, and 1800 UTC
7 Dec at 0000, 0600, 1200, and 1800 UTC

The “January” CFSv2 ensemble:

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For each year you get this:  (only 2007 shown):
```

year	month	day	cycle	lead	lead+1	member#
2007	12	12	0	2	3	1
2007	12	12	6	2	3	2
2007	12	12	12	2	3	3
2007	12	12	18	2	3	4
2007	12	17	0	2	3	5
2007	12	17	6	2	3	6
2007	12	17	12	2	3	7
2007	12	17	18	2	3	8
2007	12	22	0	2	3	9
2007	12	22	6	2	3	10
2007	12	22	12	2	3	11
2007	12	22	18	2	3	12
2007	12	27	0	2	3	13
2007	12	27	6	2	3	14
2007	12	27	12	2	3	15
2007	12	27	18	2	3	16
2007	1	1	0	1	2	17
2007	1	1	6	1	2	18
2007	1	1	12	1	2	19
2007	1	1	18	1	2	20
2007	1	6	0	1	2	21
2007	1	6	6	1	2	22
2007	1	6	12	1	2	23
2007	1	6	18	1	2	24

This yields February monthly mean data At “lead 1”.

Outcries:

1. I wish we worked with daily (instantaneous) data only, not monthly (mean) data. (19th century is gone)

2. Why can't all forecasts start on the 1st of the month at 0Z?

Analysis of SEC of 35++ Years of forecasts made in conjunction with the NCEP Climate Forecast System Reanalysis (CFSR)

Huug van den Dool and Suranjana Saha
NCEP/NWS/NOAA

Estimation of SE:

Climatology is determined at each grid-point for each lead (day 0 to day 5) by the annual mean plus 4 harmonics (period 365.24/n days, n=1,4), fitted to 1981-2010 unfiltered 10,957 data points, both analyses and forecasts. Period is thus 1981-2010 for climatology.

SE correction (SEC) is implicit, by subtracting the lead dependent model climatology from a particular forecast.

15 variables were studied, in three domains, NH, TR and SH

	PREStrp	T70 T300 T700 T975 Tsig995	Z200 Z500	Chi200	psi200 psi850	dewpnt	pwat	srfpr	w500

Example Z200.

Metric is Anomaly Correlation (AC) at day 5, by month, over the period 1979-2014, up to date, hot off the press!.

(But we looked at RMSE also.)

AC, Z200, NH, 5 day forecasts

Best overall year=2010 (90.4)
Worst overall year=1988 (82.0)
Best overall month=Feb (89.6)
Worst overall month=Jul (80.5)
Best single month=Feb 2014 (93.8)
Worst single month=Jul 1979 (75.4)

jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	all mths	year
88.5	87.6	86.1	84.3	82.3	79.1	**75.4**	79.5	77.3	81.0	84.4	84.7	83.79	1979
87.1	85.8	86.2	83.0	78.4	76.2	75.4	77.1	78.3	78.0	80.6	84.5	82.06	1980
87.5	87.3	89.3	77.6	81.0	80.1	74.3	78.2	80.4	84.7	84.7	88.7	84.22	1981
86.4	92.4	87.0	85.8	80.7	78.2	78.2	81.3	80.5	84.2	84.0	85.1	84.87	1982
87.2	89.4	86.1	82.0	78.9	78.0	76.0	78.8	79.0	81.1	86.0	90.2	84.18	1983
88.2	86.2	90.3	83.6	79.5	77.7	80.8	76.6	81.6	86.2	82.3	87.6	84.65	1984
88.3	89.3	87.3	81.6	78.9	76.7	77.4	78.8	81.5	82.6	87.4	85.2	84.38	1985
84.2	88.8	88.2	81.0	79.9	75.2	76.3	81.0	84.1	82.4	85.6	84.3	83.64	1986
85.1	86.8	85.5	82.0	77.0	77.0	78.7	80.9	80.6	83.2	84.4	86.4	83.11	1987
82.8	82.6	87.1	83.0	78.1	80.8	79.5	78.6	78.8	80.5	81.6	84.8	**82.03**	1988
89.6	89.3	89.1	84.3	81.8	80.2	78.9	78.7	79.1	81.6	84.9	88.8	85.51	1989
86.5	90.9	90.6	87.1	82.9	75.8	78.8	77.5	81.4	80.9	85.7	87.7	85.64	1990
88.4	87.0	86.8	85.2	81.1	79.3	80.1	82.5	80.3	82.2	87.5	87.5	84.90	1991
86.0	87.0	88.0	87.1	86.7	81.1	80.8	81.1	83.3	87.6	86.7	86.4	85.69	1992
88.7	90.3	89.5	85.9	86.0	78.5	81.4	82.5	84.2	83.1	83.7	84.2	85.79	1993
88.1	88.7	88.0	87.3	81.5	81.9	78.9	82.9	83.5	84.3	84.2	87.0	85.53	1994
89.4	88.9	89.7	86.7	82.9	80.3	80.8	82.1	85.5	81.9	86.4	90.5	86.54	1995
90.5	90.1	89.7	88.9	83.9	84.2	80.3	82.7	83.9	82.7	86.4	90.5	87.24	1996
87.5	90.4	87.5	88.9	83.3	80.3	79.4	78.6	84.3	85.4	88.9	86.5	86.12	1997
86.7	89.9	87.1	88.3	82.7	81.7	82.1	79.5	83.1	83.6	86.6	88.0	85.79	1998
89.9	90.7	89.7	86.1	83.0	82.6	80.9	82.2	81.3	86.2	84.7	90.3	86.70	1999
91.6	87.0	90.5	86.0	84.6	82.2	83.0	79.9	82.5	85.9	87.8	87.1	86.75	2000
86.7	89.1	89.7	86.7	84.4	82.9	81.7	80.5	83.3	84.7	88.2	92.1	86.90	2001
89.9	88.3	87.4	87.0	85.5	82.8	79.8	81.8	83.5	88.3	89.5	88.5	86.86	2002
90.8	89.9	89.9	89.5	85.9	82.1	81.7	84.5	82.3	85.8	88.3	87.9	87.32	2003
90.8	89.3	90.1	86.6	86.5	82.5	82.3	82.7	80.8	84.4	86.2	86.6	86.51	2004
89.9	90.3	91.9	89.5	86.3	78.8	84.4	81.4	81.4	84.7	89.4	90.2	87.80	2005
90.8	92.7	90.1	87.1	88.3	81.9	82.3	82.6	83.3	83.2	88.3	89.9	87.82	2006
91.6	89.4	90.5	90.0	84.5	85.7	85.0	83.7	87.8	84.6	87.4	89.1	88.07	2007
90.8	90.6	91.2	88.4	84.3	82.8	80.6	82.4	83.0	85.4	88.1	89.1	87.40	2008
92.2	93.1	87.4	86.3	85.3	84.0	82.9	83.1	85.9	87.9	88.3	90.9	88.36	2009
91.8	92.7	91.3	89.1	88.1	85.2	86.4	87.8	89.3	88.7	90.8	93.6	**90.39**	2010
92.3	91.8	91.7	91.3	86.9	83.8	82.7	83.3	87.5	86.2	88.5	89.5	89.02	2011
89.5	90.6	91.0	89.5	86.7	82.5	83.9	85.2	85.4	88.6	88.8	90.3	88.42	2012
89.5	92.1	90.1	90.8	88.6	85.6	81.5	82.1	83.6	89.2	88.3	92.1	88.76	2013
89.8	**93.8**	89.9	89.6	88.8	83.0	82.2	85.2	83.4	xxxx	xxxx	xxxx	88.72	2014
88.8	**89.6**	**89.0**	**86.4**	**83.7**	**80.9**	**80.5**	**81.4**	**82.7**	**84.5**	**86.5**	**88.4**	**86.18**	**ALL**

5-day anomaly correlations CFSv2, 1979-present, 0Z data

	AC			SEC Contribution		
	NH	SH	TR	NH	SH	TR
T70	92	91	77	0.6	0.3	1.2
Z200	86	81	88	1.1	0.9	18.6
Psi200	86	81	76	0.9	0.7	2.1
Psi850	83	78	77	1.4	0.9	3.0
Z500	83	77	84	0.5	0.6	15.9
T700	78	67	62	0.8	0.9	2.9
Srfpr	77	72	62	4.8	2.1	19.4
T975	76	62	72	3.2	2.4	2.4
Tsig995	72	57	64	3.5	2.3	2.9
T300	72	68	71	1.4	0.9	9.2
Chi200	71	69	68	2.9	2.8	2.9
Dewpnt	65	52	58	2.3	1.8	2.5
PREStrp	59	55	47	1.2	0.5	0.5
Pwat	55	51	56	0.9	0.5	2.0
W500	38	33	25	0.1	0.1	0.4

Inhomogeneity of true SE at a given moment in time can be expected on many grounds:

1. The climate is not constant. So a correction of a temperature bias, based on hindcasts in 1981-2010, may no longer apply in full in 2011, or 1980 for that matter.

2. The initial states become better over time, forecasts become better (even in a constant model). Is bias affected by that? Answer for short lead: yes. Answer for long lead: not sure.

3. The model, the data and method of data assimilation is not truly constant. Most notably in 2010 we went from CFSR model to CFSv2 model.

4. Systematic error may have flow dependence, or flavor of the year, pentad or decade.

But how bad is it? Is SE correction a small or a big problem in the face of multiple inhomogeneities?

jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	yr	
0.0	0.7	0.5	0.6	0.8	1.3	1.7	2.5	1.0	1.1	0.9	0.9	0.84	1981
1.4	1.1	1.4	1.0	0.7	0.8	1.3	1.2	1.5	0.9	0.7	1.4	1.15	1982
1.0	0.5	0.8	1.6	1.2	1.1	1.1	2.4	1.6	1.5	1.1	1.1	1.16	1983
1.0	0.9	0.7	1.2	1.1	0.6	1.1	1.0	0.7	1.2	0.8	0.7	0.94	1984
0.4	1.1	1.2	0.6	0.8	1.2	0.4	1.2	0.9	0.5	0.9	1.1	0.89	1985
1.2	0.6	1.3	1.5	0.7	1.1	1.1	1.3	0.6	0.5	1.3	0.9	0.99	1986
0.8	0.0	-0.1	0.3	0.3	1.0	0.6	0.2	0.3	0.5	1.0	0.5	0.44	1987
0.2	0.4	0.3	-0.3	1.2	0.4	1.1	1.4	1.1	0.7	1.2	1.1	0.67	1988
0.8	1.0	0.5	0.9	1.1	0.8	1.1	0.6	1.4	1.7	1.9	0.9	1.13	1989
1.0	0.8	0.4	0.6	0.8	1.1	0.5	1.1	0.9	1.2	1.0	0.6	0.83	1990
0.2	0.1	0.4	0.7	1.5	1.5	1.6	2.0	1.4	1.3	1.3	1.1	0.97	1991
0.3	1.0	0.5	0.2	0.8	0.5	0.0	0.7	1.4	0.9	1.9	1.4	0.90	1992
1.0	1.0	0.6	0.8	0.7	1.0	1.1	1.5	1.1	1.0	0.8	1.7	1.00	1993
1.2	0.9	0.8	1.2	1.0	1.5	1.4	1.8	1.7	1.6	1.8	1.1	1.28	1994
0.3	0.5	-0.1	0.5	0.4	0.7	0.8	1.2	0.9	0.7	0.7	0.1	0.46	1995
0.7	0.3	0.1	0.1	1.1	1.1	1.2	0.7	0.1	1.1	1.0	1.0	0.68	1996
0.4	1.2	0.5	0.4	0.0	0.8	0.7	1.6	1.2	0.6	1.1	1.1	0.79	1997
1.1	0.9	1.2	1.4	1.5	1.2	2.0	3.2	2.0	2.4	1.4	1.7	1.54	1998
1.1	0.7	1.2	0.6	1.0	1.8	0.8	0.9	0.7	1.0	0.5	0.8	0.89	1999
0.4	0.5	0.4	0.4	1.2	1.2	1.0	1.7	1.4	1.1	0.9	0.8	0.84	2000
0.4	0.7	0.8	1.5	1.2	1.5	1.7	2.7	2.0	2.4	1.8	1.2	1.37	2001
1.6	1.7	1.4	1.6	1.5	1.8	1.5	1.8	2.3	1.1	1.4	0.8	1.46	2002
1.1	1.0	1.2	1.4	1.5	1.7	2.1	2.4	2.5	1.6	1.4	1.7	1.53	2003
0.9	1.1	1.3	1.2	1.5	1.3	1.8	2.2	2.7	2.3	1.8	1.5	1.56	2004
1.3	1.2	1.0	1.1	0.7	1.6	2.0	1.8	2.8	1.6	1.3	0.4	1.24	2005
1.0	0.5	1.0	1.5	1.1	1.0	2.3	3.1	1.9	2.4	1.8	1.8	1.46	2006
1.4	1.0	1.4	1.1	0.8	1.0	1.3	2.6	2.2	2.8	1.7	1.7	1.57	2007
1.3	1.5	1.8	1.8	0.9	1.2	2.6	1.5	2.2	2.5	2.3	1.6	1.77	2008
1.1	0.9	1.8	1.9	1.0	1.0	2.0	2.6	2.2	1.7	1.8	1.0	1.50	2009
0.5	0.2	0.3	0.3	0.7	1.2	0.8	1.1	0.8	0.5	0.5	0.1	0.48	2010
0.9	0.8	0.9	0.9	0.9	1.1	1.4	1.7	1.4	1.4	1.2	1.0	1.09	ALL

jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec	yr	
1.0	1.3	1.6	1.4	0.4	0.9	1.3	0.0	0.5	0.4	1.4	0.7	1.01	1979
0.0	0.5	1.1	0.7	0.1	1.0	2.0	0.9	0.6	0.4	0.2	0.2	0.52	1980
0.0	0.7	0.5	0.6	0.8	1.3	1.7	2.5	1.0	1.1	0.9	0.9	0.84	1981
1.4	1.1	1.4	1.0	0.7	0.8	1.3	1.2	1.5	0.9	0.7	1.4	1.15	1982
1.0	0.5	0.8	1.6	1.2	1.1	1.1	2.4	1.6	1.5	1.1	1.1	1.16	1983
[illegible]	0.9	0.7	1.2	1.1	0.6	1.1	1.0	0.7	1.2	0.8	0.7	0.94	[illegible]
[illegible]	1.1	1.2	0.6	0.8	1.2	0.4	1.2	0.9	0.5	0.9	1.1	[illegible]	[illegible]
[illegible]	0.6	1.3	1.5	0.7	1.1	1.1	1.3	0.6	0.5	1.3	0.9	[illegible]	[illegible]
[illegible]	0.0	-0.1	0.3	0.3	1.0	0.6	0.2	0.3	0.5	1.0	0.5	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0.8	1.0	0.5	0.9	1.1	0.8	1.1	0.6	1.4	1.7	1.9	0.9	1.13	1989
1.0	0.8	0.4	0.6	0.8	1.1	0.5	1.1	0.9	1.2	1.0	0.6	0.83	1990
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.97	1991
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.90	1992
1.0	1.0	0.6	[illegible]	0.7	1.0	1.1	1.5	1.1	1.0	0.8	1.7	1.00	1993
1.2	0.9	0.8	1.2	1.0	1.5	1.4	1.8	1.7	1.6	1.8	1.1	1.28	1994
0.3	0.5	-0.1	0.5	0.4	0.7	0.8	1.2	0.9	0.7	0.7	0.1	0.46	1995
0.7	0.3	0.1	0.1	1.1	1.1	1.2	0.7	0.1	1.1	1.0	1.0	0.68	1996
0.4	1.2	0.5	0.4	0.0	0.8	0.7	1.6	1.2	0.6	1.1	1.1	0.79	1997
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.54	1998
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.89	1999
0.4	0.5	0.4	0.4	1.2	1.2	1.0	1.7	1.4	1.1	0.9	0.8	0.84	2000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.4	1.8	1.2	1.37	2001
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.1	1.4	0.8	1.46	2002
1.1	1.0	1.2	1.4	1.5	1.7	2.1	2.4	2.5	1.6	1.4	1.7	1.53	2003
0.9	1.1	1.3	1.2	1.5	1.3	1.8	2.2	2.7	2.3	1.8	1.5	1.56	2004
1.3	1.2	1.0	1.1	0.7	1.6	2.0	1.8	2.8	1.6	1.3	0.4	1.24	2005
1.0	0.5	1.0	1.5	1.1	1.0	2.3	3.1	1.9	2.4	1.8	1.8	1.46	2006
1.4	1.0	1.4	1.1	0.8	1.0	1.3	2.6	2.2	2.8	1.7	1.7	1.57	2007
1.3	1.5	1.8	1.8	0.9	1.2	2.6	1.5	2.2	2.5	2.3	1.6	1.77	2008
1.1	0.9	1.8	1.9	1.0	1.0	2.0	2.6	2.2	1.7	1.8	1.0	1.50	2009
0.5	0.2	0.3	0.3	0.7	1.2	0.8	1.1	0.8	0.5	0.5	0.1	0.48	2010
0.2	0.8	0.5	0.8	1.1	1.4	1.9	1.8	0.7	0.9	0.8	0.8	0.81	2011
0.9	0.5	1.1	1.1	1.0	1.1	2.1	2.1	1.8	1.1	0.4	0.8	1.05	2012
1.0	0.8	0.7	0.7	0.9	1.0	2.0	2.4	1.8	1.2	1.2	1.0	1.08	2013
1.3	0.7	1.3	1.3	0.9	1.7	2.0	1.9	2.0	-9999.0	-9999.0	-9999.0	1.29	2014
0.8	0.8	0.8	0.9	1.0	1.2	1.5	1.7	1.4	1.4	1.2	1.0	1.09	all

Now the years outside 1981-2010!!!

There is nothing alarmingly wrong!!!! with Z200 SEC in real time.

The efficacy of SEC, by year (all 12 months), dependent years only

Chi200 NH

3.24	1981	0.13	2001
2.93	1982	2.29	2002
3.73	1983	2.12	2003
5.30	1984	-0.24	2004
3.33	1985	1.80	2005
3.63	1986	0.50	2006
3.93	1987	-0.14	2007
6.31	1988	2.77	2008
4.12	1989	1.21	2009
1.55	1990	-2.19	2010
2.79	1991		
3.18	1992		
5.23	1993		
6.59	1994		
5.35	1995		
5.50	1996		
2.59	1997		
5.89	1998		
3.41	1999		
2.53	2000		

Years 2001-2010 behave differently using the same 1981-2010 SE.
Inside dependent data

Z200 TR

3.63	1981	35.91	2001
3.97	1982	36.36	2002
16.77	1983	35.53	2003
0.34	1984	37.06	2004
0.39	1985	22.72	2005
2.37	1986	31.65	2006
23.81	1987	31.82	2007
13.41	1988	27.36	2008
2.73	1989	29.92	2009
13.37	1990	7.81	2010
10.85	1991		
5.52	1992		
7.79	1993		
8.85	1994		
24.76	1995		
8.6	1996		
20.82	1997		
21.97	1998		
9.91	1999		
12.21	2000		

Thank you, and Conclusions